A SUGGESTED PROGRAM FOR GENERALIZED, ADULT SCIENCE EDUCATION

by

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PREFACE

A nation-wide effort is being made to provide better science education in our schools. In order to do this, we are increasing the time allocated to science, we are buying more and better equipment and books, and we are spending large sums of money in up-dating the scientific background of many of our science teachers.

All these efforts are directed primarily toward the future. Our present general adult population is becoming increasingly illiterate with respect to the tremendous changes in modern science.

We need some program to make our general adult population more aware of our Scientific Revolution, its achievements, its nature, and its implications. Such a program should also stimulate the individual adults to continue reading and studying.

The program suggested in this paper has grown out of the writer's experiences in Summer Institutes for Science Teachers at the University of Oklahoma and an Academic Year Institute at Oklahoma State University. The National Science Foundation made these experiences possible.

Indebtedness is acknowledged to Dr. Carlton W. Berenda of the University of Oklahoma for the idea of the thematic approach, and to Dr. Horace H. Bliss, also of the University of Oklahoma, for suggesting its application to adult education in a local setting. The writer also is indebted to Dr. James H. Zant of Oklahoma State University for his kind patience and encouragement in the writing of this report.

Reference to the many other persons who have contributed inspiration,

understanding, and knowledge is omitted because such a list would be too long.

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CHAPTER I

THE PROBLEM

As our modern social structure seeks to accommodate itself to the vertiginous developments of the Scientific Revolution, our public educational system is beset with an almost chronic series of emergencies which are compelling re-evaluations and revisions of our basic educational philosophies and practices. Especially in the fields of science and technology we are confronted with arguments of quality versus quantity.

Threat to Survival

The advent of Sputnik I served to break through the almost lethargic indifference to the impact of the Scientific Revolution. Through the following near-hysteria the public has been made more aware of its vital stake in our public educational system. However, frantic attempts to copy the educational patterns of other countries or transposition in toto of foreign programs and methods of education will not suffice. We must develop our own program of education suitable to our distinctive needs, and dynamic and flexible enough to provide leadership in a so-rapidly changing world.

The Democratic Philosophy of Education

One of the cherished fundamental values which we feel to be threatened is "freedom." Yet this "freedom" rests not on authoritarian programs or exclusive privileges but on a self-disciplined, adequately educated public.

The writer is very conscious of the relationship between public education and freedom after having been intimately connected with the educational program of Cuba for six years.

Adequate public education involves not only quality training of the individual to his capacity but also the provision of such educational opportunity for each individual. As C. Scott Fletcher, president of the Fund for Adult Education said in an address given to the Oklahoma Adult Education Association in Oklahoma City on January 7, 1958: The goal of a free society is that each individual should realize to the fullest his unique potentialities; the logic is toward a nation of self-governing persons, each an end in himself, each a means to self government. . . .the totalitarian or closed society seeks to render all its members except the rulers incapable not only of decisions but also of even wanting to make decisions. The free or open society seeks not only to encourage all its individuals to want to make decisions but also to fit them to make wise and humane decisions.[1]

Democratic education depends upon more than technical "know-how." Individual and collective integrity, and mutual concern and sensitivity are indispensable to democracy and freedom. Basically, these are spiritual qualities, and are more basic and vital than technical knowledge or skills. While our kind of democracy implies separation of state and religion (as sectarianism), there can be no isolation of spiritual values.

Comparative Educational Levels

Democratic education does not imply that all individuals should be run

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[1] C. Scott Fletcher, "The Battle of the Curriculum in the Sputnik Age," Adult Education, VIII, Autumn, 1958, p. 116.

through the same mold.[2] On the contrary! Our system proposes that each person should have equal opportunity to be educated according to his capabilities. In practice we fall short of this goal for various reasons.

Critics point to the shortcomings of our system and often compare the educational standards at different levels in our schools with supposedly comparable levels in foreign countries. In most such cases our system usually is made to appear inferior. However, if educational standards are compared for the general publics of the countries in question, our own standards do not suffer so much in comparison.

Whether or not the comparisons are favorable or unfavorable is not so important as whether we are doing our utmost to keep lifting our educational standards and opportunities to the highest possible levels. Self-satisfaction over past efforts, achievements, and levels is not enough. We must be creative and dynamic in our educational endeavors.

Challenge and Opportunity

The Scientific Revolution is an intriguing aspect of human development. It was fostered in part by education, yet it voraciously requires increasing education of society to maintain its mushrooming growth. Today, the mass of human knowledge and experience is accumulating at such a staggering rate that specialists have to concentrate on increasingly narrower fields. We must develop specialists. Yet we must raise the educational level of the general public so that proper perspective may be maintained.

Our grandfathers' generation considered a few years of elementary

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[2]Cf. Sydney Hook, "What Is Education?", Education in the Age of Science, Brand Blanshard, ed., (New York, 1959), p. 16 "To say that all children have the same right to an education is not to say that all have the right to the same education."

education sufficient--at least to learn the fundamentals of the three R's. Per capita economic production was low, and the necessity to work precluded a higher level of general public instruction. Later, eight years of education and graduation from "grammar" school became possible on a general basis.

Another generation found graduation from high school after twelve years of formal schooling satisfactory. But today's generation is finding that even a bachelor's degree after sixteen years in school is not enough to prepare adequately. How long can we keep extending the process of full-time, formal education and postponing the actual advent of the individual as a full-fledged member of society? Perhaps we need to take a new approach to the problem of continually extending the processes and program of education.

Paradoxically, the Scientific Revolution is making education more difficult and complex by the very nature of its increasing ramifications, while, simultaneously, it is making available the resources and the time with which to obtain an education.

Per capita economic production has increased to the point where children do not have to work in order for the family to survive as a unit. In fact, we have laws prohibiting child labor and providing for compulsory school attendance up to a certain age. Even those persons who do work have had their working hours per week cut to the point where creative use of leisure time has become a real social problem. Are we using this extra time to best advantage?

The ever extending life-expectancy span also brings problems as well as opportunities. The longer a person lives, the more there is to learn, and the more inadequate is his formalized, terminal education. Yet his longer life, his economic independence, and his increased leisure time

afford unique opportunities for continuing education.

New Concepts of Education

This is not fundamentally a matter of over-crowded schools, of "basic" courses in the curriculum, of underpaid teachers, of the length of the period of compulsory "schooling", or even of the opportunity to get a "higher" education. It is a matter of fundamental concepts of the nature of education.

Traditionally, education has involved the vertical transmission of knowledge, skills, understandings, etc. from relatively mature and experienced teachers to young, immature, and inexperienced pupils. What is in process of developing is a whole new dimension of learning--what Margaret Mead calls "the lateral transmission to every sentient member of society, of what has just been discovered, invented, created, manufactured, or marketed."[3]

The world of rapid change has forced two great agencies, the armed services and industry, into the educational field, and they have developed their own programs of continuing education. They have realized through necessity that the rate of change has become so accelerated that adjustment cannot be postponed to the next generation.

Neither can "our way of life" be preserved in this dynamic, fluid situation only by educating the "next generation" in the traditional manner. Adults are the foundation of our democratic society. It is they who share the responsibilities of governments, who make the decisions in all areas of life, and who produce and reproduce. And it is essential, especially in these times, that they be educated (not just propagandized) for rapid and

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[3]Margaret Mead, "A Redefinition of Education", NEA JOurnal, October, 1959, p. 15.

conscious adaptation to our changing world. Education should be a continuous process from "womb to tomb."[4]

The Popularization of Science

According to the President's Science Advisory Committee in its report, "Education for the Age of Science,"[5] 'a democratic citizenry today must understand science in order to have a wide and intelligent democratic participation in many national decisions.'[6] Among other things, "citizens must have at least a general knowledge and understanding of the nature of science and its implications for the national defense and welfare."

Science itself is dependent on public understanding in order to support a sustained program of science education and research, to recruit personnel, and to provide a creative, sympathetic atmosphere.[8]

Since the rate of scientific development has increased so sharply the last two decades, it is the adults who are proportionately the most illiterate scientifically speaking. Their "formal" education terminated before modern science really began to penetrate the curriculum. 'There is, therefore, no escape from the urgency of providing high-grade and plentiful

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[4]Cf. John Angus Burrell, A History of Adult Education at Columbia University, (Morningside Heights: 1954) p. 83, quoting Charles W. Eliot: "...the question of education...should really be the work of the whole life."

[5]Quoted by John Troan in "Science Reporting - Today and Tomorrow," Science, CXXXI, April 22, 1960, p. 1193.

[6]Cf. also Richard C. McCurdy (President, Shell Chemical Corporation), "Toward a Population Literate in Science," The Science Teacher, XXV, Nov., 1958, p. 367.

[7]Alan T. Waterman (Director of the National Science Foundation), "National Science Foundation: A Ten-Year Resume," Science, CXXXI, May 6, 1960, p. 1349.

[8]Cf. Jean Rostand, "Popularization of Science," Science, CXXXI, May 20, 1960, p. 1491.

adult education in science now, planned for those who are unprepared even in the fundamentals.'[9]

Adult Education - "To Be or Not to Be"

No longer is it a question whether or not we should educate adults. Adult education is a growing reality.

John B. Holden[10] says there were 8,000,000 adults in the United States in 1958 who were enrolled in and attending a series of adult education classes "which met three or more times." Malcolm Knowles, executive director of the Adult Education Association, estimated that there were over 40,000,000 Americans taking spare time courses in 1957-1958, and that there were over 5,000,000 part time instructors and leaders and field workers.[11] The President's Committee on Education beyond the High School, on p. 66 of its Second Report to the President, Washington, D.C., 1957, states that over 49,000,000 adults in the United States in 1955 were in formal and informal adult education programs, including programs sponsored by churches, clubs, unions, etc.[12]

This same report indicates that in this movement four major educational complexes have evolved: (1) our traditional system of schools and colleges; (2) an elaborate educational program under the armed services; (3) a mushrooming system of education operated by private business for its employees; (4) and a great variety of programs of continuing education under the broad

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[9]Troan, p. 1193 quoting the President's Science Advisory Committee's report, "Education for the Age of Science."

[10]John B. Holden, "A Survey of Participation in Adult Education Classes," Adult Leadership, April, 1958, p. 258.

[11]T. F. James, "Adult Education," Education Digest, XXIII, June 1959, pp. 38-40.

[12]Cited in C. E. Chapman, "Some Characteristics of Adult Part-Time Students, "Adult Education, X, Autumn, 1959, p. 27.

title of "adult education." "The rapid and parallel growth of these four educational areas reveals the enormous demand for education in our society...[13]

Can Adults Learn?

Experience with G. I. students has convinced many college educators that mature, serious minded adults with definite goals can compete adequately on the scholastic level with less mature students.[14] Charles E. Chapman, in a study of 6,610 adult part-time students in Contra Costa County, California, concludes on the basis of comparative test scores "that adults have learning abilities equal to those of youth.[15] A comparison of age and scholastic aptitude of the same group showed a positive relationship. "A constant rise in test scores occurred up to the middle age range (36-40 years), and there was no clear-cut indication of a lowering of aptitude because of age, thus challenging the idea that learning ability decreases with age."[16] Chapman also cites an English study by J. McLeish to the effect that "capacity for learning has no univocal relationship with age, but is a function of the individual subject and his previous experience."[17]

Ambrose Caliver, Assistant to the U.S. Commissioner of Education, and Chief of the Adult Education Section states: "No longer is it an issue whether adults can learn. They can and will."[18]

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[13]The President's Committee on Education Beyond the High School, in Second Report to the President, "the Revolution in American Education," condensed in Education Digest, XXIII, Nov., 1957, pp. 5-6.

[14]Cf. Burrell, pp. 90 ff.

[15]Chapman, p. 38.

[16]Ibid., p. 41.

[17]J. McLeish, "The Age Factor in Adult Education," Research and Studies, VI, May, 1952, p. 41 - cited by Chapman, ibid., p. 39.

[18]Ambrose Caliver, "The National Concern for Adult Education," Education Digest, XXIII, Oct., 1957, p. 34.

CHAPTER II

SOME DEVELOPMENTS IN OKLAHOMA

Although the purpose of this report does not include a comprehensive survey of all that has been done throughout the state of Oklahoma in the field of generalized, adult education in modern science, it would be well to note some things that are being done.

Agencies and Programs

The military establishments, private industry, and technical societies and associations conduct certain training or informational programs more or less for their own personnel. These programs are usually technical in nature and not open to the general public.

Various cultural institutions such as museums, libraries, etc. offer facilities and sometimes a limited type of program which may be broadly construed as contributing to education in or about science, but their outreach and effect is not great in terms of general need for making our adult population scientifically literate.

The public schools of the state are strategically located and by tradition are probably best indicated to serve as foci for a generalized, adult education program in science. Many school systems, such as the one in Tulsa, have developed evening programs aimed primarily at adults, but most of their courses are designed to increase skills for economic betterment in accordance with "felt needs."

Educational television, with outlets in Oklahoma City, Norman, and

Tulsa can be an effective agency in generalized, adult science education. Some commercial television stations also are carrying network offerings like Continental Classroom, which has many viewers throughout the state.

The Frontiers of Science Foundation, an Oklahoma institution, has developed a program aimed primarily at youth. Likewise, Science Service of Oklahoma, affiliated with the national organization, works with students through science fairs and science clubs. Science Service also maintains an informational service for science and mathematics teachers of the state but has no resources for a general, adult science program.

The national government in view of the critical shortage of well trained mathematics and science teachers, engineers, and scientists, has financed a program of up-grading, organized and directed in Oklahoma principally by our two state universities. Oklahoma State University (at Stillwater) has been entrusted with developing a regional Visiting Science Teacher program which not only reaches into the schools but also helps to popularize science through lectures to luncheon clubs, civic organizations, and other adult groups.

Oklahoma State University likewise was honored by being chosen as one of the two institutions in the country to pioneer an Academic Year Institute program for the National Science Foundation. O.S.U. also has Summer Institutes, In-Service Institutes, and Research and Fellowship programs under the National Science Foundation. These programs, however, are aimed primarily at improving science and mathematics instruction for secondary schools and colleges.

The University of Oklahoma (at Norman) conducts Summer Institutes and In-Service Institutes under National Science Foundation allocations and also participates in the National Science Foundation Research and Fellowship

programs. Again, these programs are for professionals rather than for the general adult population.

Project "Cosmogony-Evolution"

In the summer of 1959 one of the Institutes at the University of Oklahoma was organized as a pedagogical experiment in the use of a thematic approach. The theme chosen was Cosmogony-Evolution. In an evaluation by the participants near the end of the course, the concensus of opinion was that a thematic approach would be useful in giving continuity to an over-all picture of science and would be helpful in linking the specialized scientific disciplines.

The general director of the Institute program raised the question as to the value of such an approach for generalized, adult education in science. Nearly all of the Institute members expressed belief in the worth and need of such a program, and stated their willingness to participate as instructors in their local communities.

A group (including the writer) was formed to promulgate ideas for a pilot project which later was presented to the National Science Foundation's section on Special Projects In Science Education. The project was rejected on the grounds that the Foundation's immediate objective was to up-grade the preparation of science and mathematics teachers and only indirectly to develop the scientific literacy of the general adult population. The Foundation did not evaluate the merits of the project <u>per se</u>.

One of the participants in the Cosmogony-Evolution Institute, Douglass M. Modisett, at present (1960) is working on a "guideline" for the teaching of a secondary science course using this theme. An outline of the "guideline" has been distributed to other participants of the Cosmogony-Evolution

Institute for evaluation and suggestions. This outline covers description of the course, philosophy, objectives, and methodology as well as six units. Each unit is developed to include learning content, learning activities, and references and resources.

A Center for Continuing Education

A new Center for the continuing education of adults is being erected on the University of Oklahoma campus under a grant from the Kellogg Foundation and from state legislative appropriations. This center will house the usual extension services and possibly a College of Liberal Studies, which would be designed to provide continuing education for adults. The proposal for a College of Liberal Studies to grant a special baccalaureate degree is still awaiting approval by the Board of Regents.[1]

The Thematic Approach

The proposed plan of studies in the Liberal Studies program is based on themes (such as Cosmogony-Evolution), each of which would cover one of three general areas--Natural Science, Social Science, and Humanities (with Fine Arts). Then "great themes" (such as What Is Man?) would be chosen to include all three areas together. About forty basic books in each of the three areas would constitute the minimum core of material expected to be read (or known). The reading could be done in any language.

Admission would necessarily be selective, and each applicant would be expected to provide a record of his formal education. However, an essential for admission would be evidence, through a series of written tests, of one's

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[1] "Kellogg Foundation Center Progresses," The Oklahoma Daily, XLVI, June 29, 1960, p. 4.

ability to read, write, and use elementary arithmetic.

After being admitted, the student would be assigned three separate advisors, one from each of the general areas. Much stress would be put on counselling, since each student would have set up for him an individual program based on estimates of background, ability, interest, goals, available time, and other factors. Each student thus would proceed at his own pace.

Upon finishing reading and studying in each of the major areas, the student would come to the Center and take an examination. There would be a two hour, objective type test in the morning over content, and a two hour, essay type test in the afternoon to check on ability to express the ideas covered, to generalize from the information absorbed, and to see interdisciplinary relationships.

If the student passed the area examination, he would be considered as having sufficient background to enroll in an area seminar for three weeks. During this time he would choose a theme, or project, in the area and pursue this field of investigation in depth.

After having finished the work in all three major areas, the student would participate in a four week inter-area seminar using the great themes to help correlate and coordinate all the ideas and concepts from the three general areas. Then he would undergo a series of oral and written examinations, including the Princeton Graduate Record Examinations. Although no "marks" would be given at any time, the student would be expected to achieve a high level of performance before moving on to the next step, or before the B.L.S. (Bachelor of Liberal Studies) would be granted. In fact, it is porposed to make this degree more difficult to obtain than an ordinary bachelor's degree.

In spite of the high standards, it is expected that many of the more than 11 million adults within a six hour driving range[2] will enroll, either

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[2] Ibid.

as candidates for a degree or merely to "continue" their education and cultural development. Only the seminars would require residence for any long period of time, and these seminars would be held in the summer.

The Center will not be opened officially until the Spring of 1962. However, it is hoped to obtain approval of the Liberal Studies program in time to begin a pilot project in the Fall of 1960. This project would start approximately twenty five carefully chosen adults in each of the three areas in order to discover and correct all possible defects and deficiencies before the opening of the Center.

If the Liberal Studies program is approved, it is proposed to establish centers for lectures, discussion groups, and other cultural aids wherever there is a sufficient concentration of enrollees to warrant such a procedure. Thus the College of Liberal Arts would extend its influence in the realm of adult education directly into certain communities.

CHAPTER III

A SUGGESTED PROGRAM

Although many agencies are involved in some form of adult education, few if any programs are directed towards making our general adult population scientifically literate. The programs are limited either in nature or in outreach, and thus do not meet the needs nor fulfill the purposes expressed in this report. Actually, no single public institution or type of public institution can meet all these needs.[1] However, the writer believes it is pertinent to suggest a type of program which can be adapted to many local communities and so reach a maximum number of adults.

The Local Schools

Most communities with sufficient number of adults to warrant an educational program for them will also have a local school system of some kind. Such a system could provide a physical plant and other facilities designed to some extent for education, and which would usually be available in the evening when most adults could be reached. Even where an evening program is already organized, usually there is at least one room available. Furthermore, the local school system is a possible source of administrative and teaching leadership.

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[1] Cf. Chapman, p. 38.

Leadership

Local school administrators have had previous training and experience in organizing educational programs and would be familiar with many of the problems which would have to be solved. These problems would include decisions on financing, class size, admission requirements, and general organization and coordination. In most communities the local school administration would probably be the best source for administrative leadership.

Public school science teachers would be a possible source of group leadership in an adult science program. However, they might have some disadvantages.

Many (or possibly most) science teachers are relatively unaware of the profound changes which have occurred in the nature and in the philosophy of science since the beginning of this century. Most of these teachers are unaware that they are unaware. Yet, because they are "science" teachers, they are often expected to be authorities in all aspects of science.

Another possible disadvantage to be found in using regular teachers is that most have developed a style of teaching aimed at younger students. Since one's style of teaching is personal and individual, these teachers would tend to follow the same style of teaching with adults. Even ordinary college teaching techniques would probably not be suitable for generalized adult education.

The situation in an adult class drawn from the general population is not comparable to a class in our regular school systems.[2] The adults would

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[2] T. F. James, "Adult Education," Education Digest, XXIII, Jan., 1958, pp. 38-39.

probably represent a much wider range of abilities, background and maturity.

More important qualifications for group leadership than technical knowledge or skill would be sensitiveness to the needs of the group and of each individual; ability to draw out the contributions which each member can make; and ability to inspire a desire to do more than is necessary, and to continue learning on one's own.

Such qualifications are not limited to professional teachers nor necessarily found in them. Thus it is not required to confine group leadership in our suggested program to professional teachers. Many teachers, however, do have the qualities essential for good group leadership.

Leaders who wish to improve in their function might well consider investing $5.00 for a subscription to Adult Education, journal of the Adult Education Association of the U.S.A. Adult Education is published quarterly under the editorship of Thurman White at the University of Oklahoma Press, Norman, Oklahoma. White is also Dean of the Extension Division of the University.

Annual fee for professional membership in the Association costs $10, of which $2.50 pays for a subscription to Adult Education. Among other benefits, membership entitles one to purchase the Leadership Pamphlets of the Association at the reduced prices of $ .50 each or three for $1.00. The pamphlets and prices to non-members are listed under Appendix A of this report.

Methods and Resources

The basic teaching techniques probably should be voluntary reading and sharing of experiences and thought through group discussion, with no question of grades or credits involved. Thus learning tends to become an end in itself, and motivation becomes intrinsic rather than extrinsic.

According to the president of the Fund for Adult Education, "Study and discussion programs are particularly appropriate for adults. Group discussion relates the individual and society. It is best suited to those issues concerning which differences of opinion are widest, and friendly discussion of emotionally charged issues exemplifies 'the agreement to disagree agreeably' which makes self-government possible. The discussion method assumes a basic equality of all and respects the contributions of each. It draws on and stimulates other methods of learning: reflection, reading, viewing, listening. When seriously done, and when orderly and consequential, it is admirably suited to continuing education."[3]

Reading is also extremely important in order to tap the vast reservoir of accumulating knowledge and wisdom, and so to provide grist for thought and discussion. Although many communities have libraries, there are a growing number of good, inexpensive, paperback books which are readily available.

The American Association for the Advancement of Science and the National Science Foundation have collaborated in publishing a booklet, "An Inexpensive Science Library--A Selected List of Paperbound Science Books" which is available at twenty-five cents per copy from the A.A.A.S., 1515 Massachusetts Avenue, N.W., Washington 5, D.C. One interesting feature of this book list is that it briefly describes the contents of each book and grades it on the basis of estimated reading level, ranging from the upper elementary grades to the professional specialist.

This writer has used some seventy of these paperbound books in his work with eighth grade general science students to provide supplementary reading for those who maintain a certain level of achievement. This reading program has served as a stimulus to imporve work habits for a large percentage

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[3]Fletcher, p. 118.

of the students. Furthermore, many of these students have become interested in reading material other than assigned texts and comics. Many are beginning to build their own personal libraries, and each year we placed at least one large collective order to obtain bulk discounts. Replacement of tattered copies on the writer's bookshelf has been small cost compared to the satisfaction of seeing his students discover new vistas of knowledge. From this personal experience the writer is convinced that these paperback books can be an effective tool in continuing education for adults in modern science.

Where television is available, such programs as Continental Classroom, Conquest, Bell Telephone Science Series, and other, plus various offerings on educational TV channels can be used as supplementary sources of information and stimulation. Semi-fictional and fictional programs also can serve as a basis for critical evaluation in learning to apply rational methods of thought. Availability of these programs will depend, of course, upon local conditions.

The colored Bell Science Films, including, "Our Mr. Sun," "The Strange Case of the Cosmic Rays," "The Unchained Goddess," "Haemo, the Magnificent," and "The Alphabet Conspiracy," are available in 16 mm. size on a rent free basis. The larger industrial organizations often have films and other materials available at little or no cost. Most of these materials are about the technological aspects of "science," but list of available materials may be obtained for evaluation in the light of local circumstances by writing directly to the companies.

There are several books published which list and describe the free or low cost educational materials available. However, it is doubtful if the materials described would be of enough value in the type of adult program suggested to warrant the relatively high cost of purchase.

Of more practical value are the catalogues (usually available upon request) of audio-visual materials which can be obtained at reasonable cost from state universities and similar institutions. In this state, both Oklahoma University (Norman) and Oklahoma State University (Stillwater) have respectable audio-visual centers with loan and rental service.

Current publications, such as journals, magazines, newspapers, brochures, etc., serve to present scientific developments "hot off the griddle." They may also be used to practice critical reading because much non-technical reporting and even some technical reporting is apt to convey misinterpretations due to ignorance of science or to sensationalistic tendencies.

The Thematic Approach

In trying to cover all aspects of science and at the same time digest the scattered fragments of new developments, there is need for some unifying principle by which to organize one's knowledge and ideas into a meaningful whole with continuity and relationship. One way of accomplishing this is by following a broad theme into which all the content material can be tied. One such theme is Evolution.

By Evolution is meant the process of change which seems apparent to us today, and which we assume has been going on for at least billions of years, and which probably will continue. In other words, it is a concept of a dynamic Cosmos. It is not the "Evolution" of William Jennings Bryan et al.

Yet, if the word, even after careful distinction and definition, continues to recall strong emotional reactions within the group, it probably would be better to drop the term while using the concept. The writer did

this one year, and reference was made instead to "transformations of matter and energy" without loss of continuity of thought. It would seem inconsistent and inconsiderate to urge any student, adult or not, to be rational in his thinking and at the same time goad him emotionally by employing words loaded with strong emotional connotation for him.

Content

In considering the content to be included in this suggested program of science education for adults, it is necessary for the leader to take into account the amount of time allotted, the size and nature of the group, the capacity and experience of the individual members, the personal and material resources available, his own particular capabilities, and other factors. It will be up to the local leader to select the content material he believes would be best in the local situation. Since the general pattern must be flexible, only some rather broad areas will be suggested.

The leader might begin by promoting a discussion designed to establish the aims of the group, and then outline briefly the general procedures and methods of learning expected to be used. Because the class is concerned with science, it would be reasonable to raise the question, What is science?

In the writer's experience, the answers to this question usually fall into three main "definitions:" (1) Science is a method of investigation; (2) Science is an organized body of knowledge; (3) Science is an attempt to observe, under stand and explain the universe. Later on in the course it would be well to work out a new definition of science.

Following up the first definition might lead the group into logic, scientific method, limitations of science, and ways of justifying belief. Metaphysics and the philosophy of science could be introduced if desired.

The second definition might lead into epistemology, the problems of division and classification, the nature of order, and even into ontology. One might also use the history of science to show how our classification system and the concepts behind them developed.

Definition number three lends itself beautifully either to a philosophical or historical approach. The leader could begin with the ancient cosmologies, especially that of Aristotle, and develop the concepts and philosophy behind them, and then present modern theories of cosmogonies, especially those of Gamow[4] and Hoyle.[5]

Beginning with the modern theories of cosmogony, the group could go into cosmological evolution down through the formation of the earth. The theory of geological evolution then would bring them down to present times. The theories of the origin of life and of organic evolution could be tied in chronologically with geological evolution or could be treated separately.

After this over-all chronological sweep, the leader could pick up the thread of thought at any point and bring out a logical development along modern scientific lines. For example, astronomy, physics, and chemistry are involved in geological evolution; paleontology, comparative anatomy, embryology, morphology, physiology, bacteriology, entomology, genetics, botany, etc. are pertinent to organic evolution. Actually, all scientific disciplines can be tied in at one or more places in the evolutionary theme.

Before terminating the course, the leader probably should bring out the idea that these theories are all concepts of the human mind and do not necessarily represent "reality." They are organizational abstractions which man has devised after applying the scientific method in his attempt to explain

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[4]George Gamow, The Creation of the Universe, (New York: 1957).

[5]Fred Hoyle, Frontiers of Astronomy, (New York: 1957).

the "sensible" (sense perceived) universe.

CHAPTER IV

SUMMARY AND CONCLUSIONS

There is a real need to provide continuing education for adults, in part because of increased leisure time and span of life, in part because the increasing accumulation of knowledge (especially in science) makes a terminal education inadequate, and in part because those who control our political structure must be able to make informed and wise decisions.

In order to make our general adult population scientifically literate, it is necessary to reach the local community. Therefore, the local school systems become the most likely centers around which to organize a program. The schools may also provide a source of administrative and group leadership.

Classes ordinarily should be organized as reading-discussion groups rather than in a traditional manner. Thus the leader's professional educational preparation is not so important as his sensitiveness to group and individual needs, and his ability to stimulate and direct discussion.

A thematic approach is suggested to provide continuity for a broad sweep across all the areas of science. One such theme is Evolution, from cosmogony to present day outcomes of Darwinism. This theme provides for chronological as well as logical development. Any suggestion, however, should be adapted to local conditions.

Since modern adult education is "continuing" education, it is hoped that any participants in this suggested program, or similarly aimed program will be stimulated to increase their own scientific literacy even more by continued reading and study.

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APPENDIX A

At present there are sixteen Adult Education Association Leadership Pamphlets available. By number they are:

No. 1. How to Lead Discussions
2. Planning Better Programs
3. Taking Action in the Community
4. Understanding How Groups Work
5. How to Teach Adults
6. How to Use Role Playing and Other Tools for Learning
7. Supervision and Consultation
8. Training Group Leaders
9. Conducting Workshops and Institutes
10. Working with Volunteers
11. Conferences That Work
12. Getting and Keeping Members
13. Effective Public Relations
14. Better Boards and Committees
15. Streamlining Parliamentary Procedures
16. Training in Human Relations

These pamphlets may be purchased from the Adult Education Association, 743 Wabash Ave., Chicago 11, Illinois, at the following prices:

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VITA

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MASTER OF SCIENCE

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